

Population Density and Social Pathology

JOHN B. CALHOUN, PH.D., *National Institute of Mental Health*

In the celebrated thesis of Thomas Malthus, vice and misery impose the ultimate natural limit on the growth of populations. Students of the subject have given most of their attention to misery, that is, to predation, disease and food supply as forces that operate to adjust the size of a population to its environment. But what of vice? Setting aside the moral burden of this word, what are the effects of the social behavior of a species on population growth—and of population density on social behavior?

Some years ago I attempted to submit this question to experimental inquiry. I confined a population of wild Norway rats in a quarter-acre enclosure. With an abundance of food and places to live and with predation and disease eliminated or minimized, only the animals' behavior with respect to one another remained as a factor that might affect the increase in their number. There could be no escape from the behavioral consequences of rising population density. By the end of 27 months the population had become stabilized at 150 adults. Yet adult mortality was so low that 5,000 adults might have been expected from the observed reproductive rate. The reason this larger population did not materialize was that infant mortality was extremely high. Even with only 150 adults in the enclosure, stress from social interaction led to such disruption of maternal behavior that few young survived.

With this background in mind I turned to observation of a domesticated albino strain of the Norway rat under more controlled circumstances indoors. The data for the present discussion come from the histories of six different populations. Each was permitted to increase to approximately twice the number that my experience had indicated could occupy the available space with only moderate stress from social interaction. In each case my associates and I maintained close surveillance of the colonies for 16 months in order to obtain detailed records of the modifications of behavior induced by population density.

The consequences of the behavioral pathology we observed were most apparent among the females. Many

were unable to carry pregnancy to full term or to survive delivery of their litters if they did. An even greater number, after successfully giving birth, fell short in their maternal functions. Among the males the behavior disturbances ranged from sexual deviation to cannibalism and from frenetic overactivity to a pathological withdrawal from which individuals would emerge to eat, drink and move about only when other members of the community were asleep. The social organization of the animals showed equal disruption. Each of the experimental populations divided itself into several groups, in each of which the sex ratios were drastically modified. One group might consist of six or seven females and one male, whereas another would have 20 males and only 10 females.

The common source of these disturbances became most dramatically apparent in the populations of our first series of three experiments, in which we observed the development of what we called a behavioral sink. The animals would crowd together in greatest number in one of the four interconnecting pens in which the colony was maintained. As many as 60 of the 80 rats in each experimental population would assemble in one pen during periods of feeding. Individual rats would rarely eat except in the company of other rats. As a result extreme population densities developed in the pen adopted for eating, leaving the others with sparse populations.

Eating and other biological activities were thereby transformed into social activities in which the principal satisfaction was interaction with other rats. In the case of eating, this transformation of behavior did not keep the animals from securing adequate nutrition. But the same pathological "togetherness" tended to disrupt the ordered sequences of activity involved in other vital modes of behavior such as the courting of sex partners, the building of nests and the nursing and care of the young. In the experiments in which the behavioral sink developed, infant mortality ran as high as 96 percent among the most disoriented groups in the population. Even in the absence of the behavioral sink, in the second series of three experiments, infant mortality reached 80 percent among the corresponding members of the experimental populations.

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